US009044977B2

(12) United States Patent
McLaughlin et al.

(10) Patent No.: US 9,044,977 B2
(45) Date of Patent: Jun. 2, 2015

(54) **SYSTEM AND METHOD FOR THREADING A WEB THROUGH A PRINTING DEVICE**

(75) Inventors: **Matthew R. McLaughlin**, Rochester, NY (US); **Victoria L. Warner**, Caledonia, NY (US); **Donald R. Fess**, Rochester, NY (US); **James L. Giacobbi**, Penfield, NY (US)

(73) Assignee: **Xerox Corporation**, Norwalk, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 820 days.

(21) Appl. No.: **13/162,849**

(22) Filed: **Jun. 17, 2011**

(65) **Prior Publication Data**

US 2012/0321366 A1 Dec. 20, 2012

(51) **Int. Cl.**

B65H 20/02	(2006.01)
B41J 15/16	(2006.01)
B41J 11/42	(2006.01)

(52) **U.S. Cl.**

CPC ***B41J 15/165*** (2013.01); ***B65H 20/02*** (2013.01); *B65H 2301/52202* (2013.01); ***B41J 11/42*** (2013.01)

(58) **Field of Classification Search**

CPC B65H 20/02; B65H 2301/522; B65H 2301/52202

USPC 226/1, 4, 12, 24, 42, 43, 44, 45, 91, 92, 226/111; 242/532.7, 562.1, 563; 400/617

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,653,536	A *	9/1953	Cooksey	101/180
3,344,740	A *	10/1967	Hilton	101/228
3,853,256	A	12/1974	Shaffstall	
4,011,975	A	3/1977	Brown, Jr.	
4,165,029	A	8/1979	Mitchell	
4,673,142	A	6/1987	Keene et al.	
4,787,546	A	11/1988	Bradbury	
4,895,318	A	1/1990	Wulfing	
4,896,808	A *	1/1990	Schaede	226/42
4,953,044	A	8/1990	Van Pelt et al.	
5,449,156	A *	9/1995	Gnuechtel et al.	270/5.02
5,480,085	A	1/1996	Smithe et al.	
5,823,936	A	10/1998	Ratzel	
5,996,492	A	12/1999	Jurkewitz et al.	
6,010,091	A	1/2000	Leskinen et al.	
6,106,177	A	8/2000	Siegl et al.	
6,120,428	A	9/2000	Ratzel	
6,357,349	B1	3/2002	Tomberlin et al.	
6,474,886	B1	11/2002	Sugiyama et al.	
6,641,314	B2	11/2003	Mogi	
6,681,695	B2	1/2004	Murakami	
6,723,206	B1 *	4/2004	Fransson et al.	162/193
7,380,747	B2	6/2008	Fromm et al.	
7,395,025	B2	7/2008	Matsuzuki et al.	
7,798,382	B2	9/2010	Zentgraf et al.	
8,555,761	B2 *	10/2013	Keily et al.	83/343
2003/0116003	A1 *	6/2003	Kapiloff	83/649
2004/0074407	A1 *	4/2004	Iyokawa et al.	101/228
2008/0036141	A1	2/2008	Liu et al.	
2008/0058979	A1	3/2008	Nakano	
2009/0057362	A1	3/2009	menzinger	
2010/0194028	A1	8/2010	Frisque	

* cited by examiner

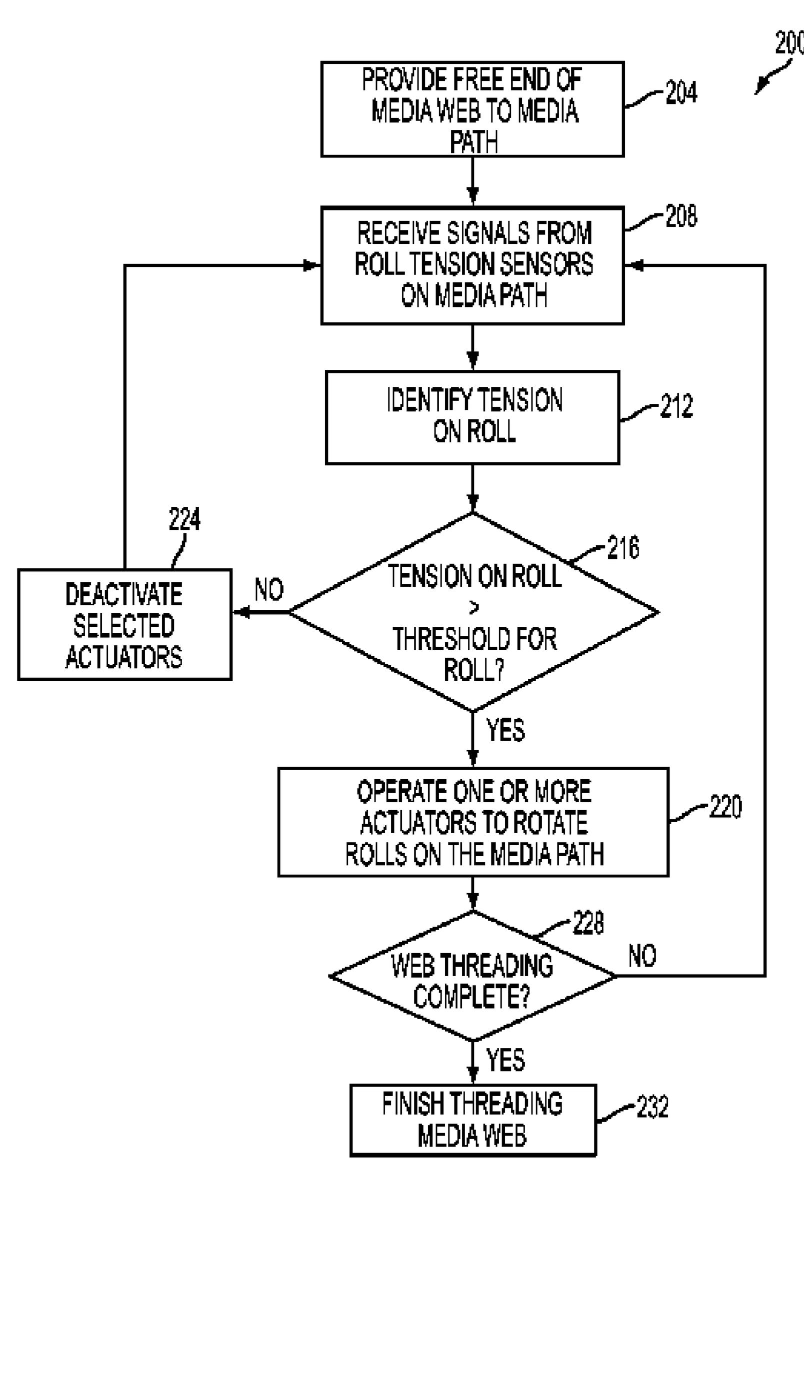
Primary Examiner — William E Dondero

(74) *Attorney, Agent, or Firm* — Maginot Moore & Beck LLP

(57) **ABSTRACT**

A method for assisting the threading of a media web in a continuous feed printer has been developed. The method includes generating an electrical signal that corresponds to a level of tension applied by a media web to a roller positioned along a media path in a printer as the media web travels over the roller. A controller activates at least one actuator to rotate a roller positioned along the media path in response to identifying that the level of tension exceeds a predetermined threshold to facilitate threading of the media web through the printing device.

12 Claims, 2 Drawing Sheets



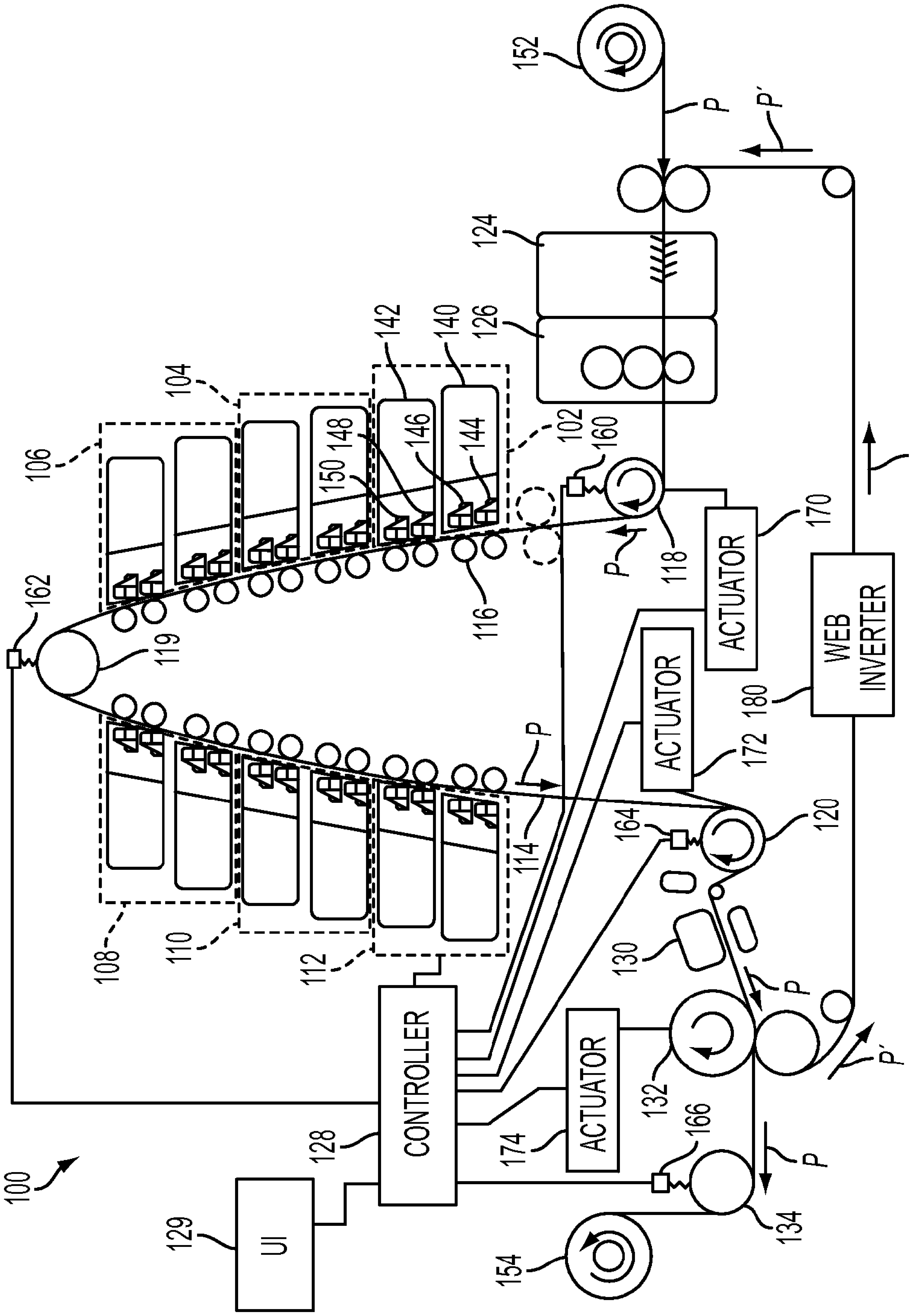

100
102
104
106
108
110
112
114
116
118
119
120
124
126
128
129
130
132
134
140
142
144
146
148
150
152
154
160
162
164
166
170
172
174
180
P
P′
ACTUATOR
ACTUATOR
ACTUATOR
CONTROLLER
UI
WEB INVERTER

FIG. 1

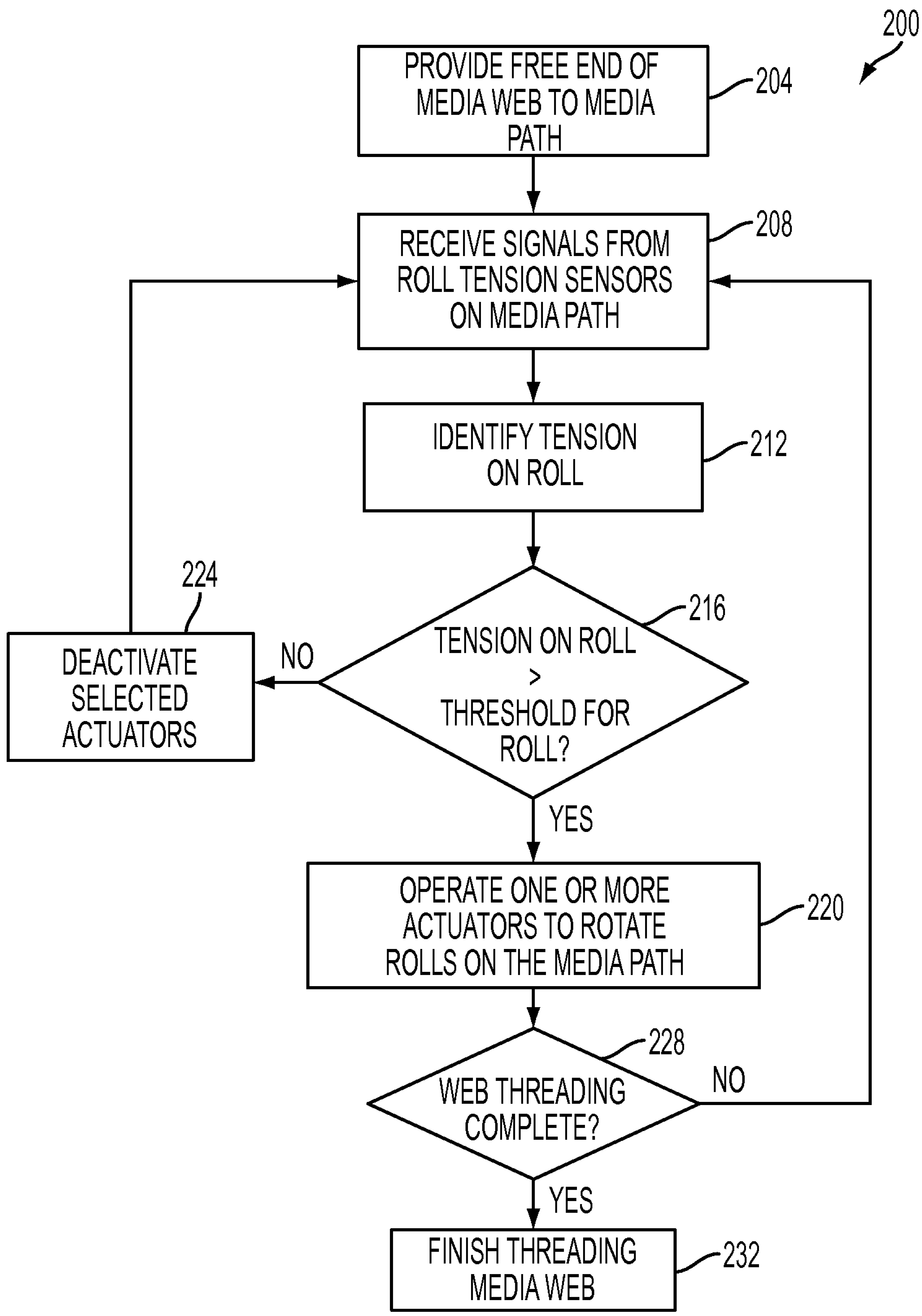

200
PROVIDE FREE END OF MEDIA WEB TO MEDIA PATH
204
RECEIVE SIGNALS FROM ROLL TENSION SENSORS ON MEDIA PATH
208
IDENTIFY TENSION ON ROLL
212
TENSION ON ROLL > THRESHOLD FOR ROLL?
216
NO
DEACTIVATE SELECTED ACTUATORS
224
YES
OPERATE ONE OR MORE ACTUATORS TO ROTATE ROLLS ON THE MEDIA PATH
220
WEB THREADING COMPLETE?
228
NO
YES
FINISH THREADING MEDIA WEB
232

FIG. 2

SYSTEM AND METHOD FOR THREADING A WEB THROUGH A PRINTING DEVICE

TECHNICAL FIELD

This disclosure relates generally to methods for threading a media web through a media path in a printing device, and more particularly to methods for activating one or more rollers to advance the web as the web advances along the media path.

BACKGROUND

Various printing devices include printers that accept individual sheets of pre-cut media or web printers that form images on a continuous web of print media. In a web printer, a continuous supply of media, typically provided in a media roller, is entrained onto rollers that are driven by motors. The motors and rollers pull the web from the supply roller through the printer to a take-up roller. As the media web moves along the media path, the imaging device forms images on the media web that may include text and graphics in one or more colors. Common embodiments of web printing systems include offset lithographic printing systems and inkjet web printing systems.

Installation of a media web in a printer to enable printing on the web requires a threading operation. A threading operation feeds a free end of the web media from the supply roller through the media path to the take-up roller prior to the commencement of printing. A threading operation can occur for various reasons. In some circumstances, a new media web replaces an exhausted media web supply. In other cases, breakage of a media web requires a remaining portion of the web roller that broke or a new web roller to be threaded through the media path. Because some media web printers use different media paths for different print modes, changes in the printing mode for a printer may necessitate a threading operation.

In a typical threading operation, a human operator pulls a free end of the media web through the media path and attaches the free end to the take up roller. Because the media paths in many web printers are long, the media path may make one or more turns through the printer. Manual manipulation of the media web in such printers can be tedious and time consuming. Some existing web printers include one or more manual switches that enable the operator to activate selectively motorized rollers positioned along the media path to assist in pulling the web through various portions of the media path. The selective activation of the motorized rollers still require the operator to pull the free end along and guide the web through the printer while engaging the switches to activate rollers as the free end approaches a still roller. If a switch is not located close enough to the free end of the web, the operator must travel back and forth between the switch and free end of the web. Thus, threading operations can be slow and require extensive operator interaction. Improvements in threading operations that enable more efficient threading of the media web would be beneficial.

SUMMARY

In one embodiment, a method of threading a media web through a media path in a printer has been developed. The method includes generating an electrical signal with a first sensor that corresponds to a level of tension applied by a media web to a roller positioned along a media path in a printer as the media web travels over the roller, and activating with a controller at least one actuator to rotate a roller positioned along the media path in response to the electrical signal generated by the sensor exceeding a predetermined first threshold to facilitate threading of the media web through the printing device.

In another embodiment, a web printing system has been developed. The web printing system includes a plurality of rollers positioned along a media path and configured to engage a media web, a sensor operatively connected to one roller in the plurality of rollers and configured to generate an electrical signal corresponding to a tension applied to the one roller by the media web while the media web is threaded through only a portion of the media path past the one roller, at least one actuator operatively configured to rotate at least one roller in the plurality of rollers, and a controller that is operatively connected to the tension sensor and at the at least one actuator. The controller is configured to identify a level of tension applied to the one roller with reference to the electrical signal, compare the identified level of tension to a first predetermined threshold, and operate the at least one actuator to rotate at least one roller in the plurality of rollers at a threading rotational speed, the threading rotational speed being slower than an operating rotational speed, in response to the identified level of tension exceeding the first predetermined threshold to facilitate threading of the media web through the media path.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of a web printing system that is configured to operate one or more actuators to move a media web along a media path.

FIG. **2** is a block flow diagram of a process for operating one or more actuators in a web printing system to assist in threading a media web through the web printing system.

DETAILED DESCRIPTION

For a general understanding of the environment for the system and method disclosed herein as well as the details for the system and method, the drawings are referenced throughout this document. In the drawings, like reference numerals designate like elements. As used herein the term "printer" refers to any device that is configured to form images on a print medium including direct imaging printing systems and offset printing systems. As used herein, the term "process direction" refers to a direction of travel of an image receiving member, such a media web along a media path in the printer. The terms "upstream" and "downstream" refer to locations that are more closely positioned to the beginning and end, respectively, of the media path. The term "cross-process direction" is a direction that is perpendicular to the process direction along the surface of the image receiving member. As used herein, the terms "web," "media web," and "continuous media web" refer to an elongated print medium that is longer than the length of a media path that the web traverses through a printer during the printing process. Examples of media webs include rollers of paper or polymeric materials used in package printing. The media web has two sides forming surfaces that may each receive images during printing.

As used herein, the term "rotational speed" refers to the angular movement of a rotating member for a given time period, sometimes measured in rotations per second or rotations per minute. The term "linear velocity" refers to the velocity of a member, such as a media web, moving in a straight line. When used with reference to a rotating member, the linear velocity represents the tangential velocity at the circumference of the rotating member. The linear velocity v for circular members may be represented as: $v=2\pi r\omega$ where r is the radius of the member and ω is the rotational speed or angular velocity of the member.

FIG. **1** depicts a continuous web printer system **100** that includes six print modules **102**, **104**, **106**, **108**, **110**, and **112**; a media path P configured to accept a print medium **114**, a controller **128**, tension sensors **160**, **162**, **164**, and **166**; and actuators **170**, **172**, and **174**. The print modules **102**, **104**, **106**, **108**, **110**, and **112** are positioned sequentially along a media path P and form a print zone for forming images on a print medium **114** as the print medium **114** moves past the print modules.

In printing system **100**, each print module **102**, **104**, **106**, **108**, **110**, and **112** in this embodiment provides an ink of a different color. In all other respects, the print modules **102**, **104**, **106**, **108**, **110**, and **112** are substantially identical. Print module **102** includes two print sub-modules **140** and **142**. Print sub-module **140** includes two print units **144** and **146**. The print units **144** and **146** each include an array of printheads that may be arranged in a staggered configuration across the width of both the first section of web media and second section of web media. In a typical embodiment, print unit **144** has four printheads and print unit **146** has three printheads. The printheads in print units **144** and **146** are positioned in a staggered arrangement to enable the printheads in both units to emit ink drops in a continuous line across the width of media path P at a predetermined resolution.

Print sub-module **142** is configured in a substantially identical manner to sub-module **140**, but the printheads in sub-module **142** are offset by one-half the distance between inkjet ejectors in the cross-process direction from the printheads in sub-module **140**. The arrangement of sub-modules **140** and **142** enables a doubling of linear resolution for images formed on the media web **114**. For example, if each of the sub-modules **140** and **142** emits ink drops at a resolution of 300 drops per inch, the combination of sub-modules **140** and **142** emits ink drops at a resolution of 600 drops per inch.

During a threading operation, a free end of the media web **114** is pulled through the media path P to prepare the printing system to generate images on the media web **114** using the print modules **102**-**112**. The free end of the media web **114** unrolls from a source roller **152** and passes through a brush cleaner **124** and a contact roller **126** prior to entering the print zone. The media web **114** is pulled along the media path P through the print zone guided by a pre-heater roller **118**, backer rollers exemplified by backer roller **116**, an apex roller **119**, and a leveler roller **120**. The media web **114** then passes through a heater **130** and a spreader **132** after passing through the print zone. The media web passes an exit guide roller **134** and then winds onto a take-up roller **154**. As described in more detail below, as printing system **100** is configured to rotate one or more rollers along the media path P to assist the threading operation. Alternative web printing system configurations may include tension sensors operatively connected to different rollers and other printer components that engage the media web **114** during threading operations.

The media path P depicted in FIG. **1** is exemplary of one media path configuration in a web printing system, but various different configurations may lead the web past different rollers and other components. Printing system **100** also includes a media path P' for an optional duplex web printer configuration. In the duplex configuration, the media web **114** passes through the media path P described above for first-side imaging, and then passes through media path P' and web inverter **180** after passing the spreader roller **132**. The web inverter flips the media web **114**, and the media web **114** then passes through the entire media path P a second time for imaging of the second side of the media web. After the second side of the media web **114** is imaged, the media web passes the exit guide roller **134** and winds onto the take-up roller **154**.

Some of the rollers positioned along the media path P that guide the media web **114** are operatively coupled to one or more actuators that rotate the rollers. The term "drive roller" refers to a roller is operatively coupled to an actuator to enable the actuator to rotate the drive roller. In FIG. **1**, actuators **170**, **172**, and **174** are operatively connected to drive rollers **118**, **120**, and **132**, respectively. The actuators **170**-**174** may be electrical motors, pneumatic rotary actuators, hydraulic rotary actuators, and the like. In printing system **100**, each actuator is operatively connected to a single roller, but in an alternative configuration a single actuator may rotate multiple rollers. The single actuator may rotate the multiple rollers at a single linear and angular velocities, or may engage each roller through a set of gears or transmission that enables the single actuator to rotate various rollers at selected linear and angular velocities.

In the configuration of FIG. **1**, each of the drive rollers **118**, **120**, and **132** engages the media web **114** at different times as the media web is threaded through media path P. Each actuator rotates a corresponding roller to urge the media web along the media path P. For example, actuator **170** rotates the pre-heater roller **118** as shown to pull the media web **114** into the print zone. The actuators **170**-**174** may rotate the corresponding rollers at different velocities during different operating modes of the printing system **100**. During a threading operation, each actuator may rotate the corresponding roller at a predetermined rotational speed to assist in threading the media web **114**. In the embodiment of FIG. **1**, the drive rollers **118**, **120**, and **132** rotate at lower angular velocities during threading operations than during imaging operations.

In FIG. **1**, some rollers positioned along the media path are operatively connected to sensors that generate electrical signals corresponding to a level of tension force exerted by the media web **114** on the roller. Examples of suitable sensors include load cells and strain gauges. In FIG. **1**, sensors **160**, **162**, **164**, and **166** are operatively connected to the pre-heater roller **118**, apex roller **119**, leveler roller **120** and exit guide roller **134**, respectively. The sensors **160**-**166** generate electrical signals that correspond to a tension force between the corresponding rollers and the media web **114**. During a threading operation, the sensors **160**-**166** generate signals corresponding to the tension between the media web and the corresponding rollers that indicate that the corresponding rollers are in contact with the media web **114**.

In the embodiment of FIG. **1**, the pre-heater roller **118** is operatively connected to sensor **160** and actuator **170**, and the leveler roller **120** is operatively connected to sensor **164** and actuator **172**. Rollers **118** and **120** are examples of a single roller coupled to a sensor for measuring tension between the roller and the media web, and an actuator that rotates the roller. The apex roller **119** and exit guide roller **134** are operatively connected to sensors **162** and **166**, respectively, but are not directly connected to an actuator. Rollers **119** and **134** are examples of rollers contact the media web **114**, but are not directly rotated by an actuator. The spreader roller **132** is operatively connected to actuator **174**, but is not directly connected to a tension sensor. Alternative printing system configurations may include rollers and other moving members along a media path that are connected to a sensor, an actuator, or a combination of both a sensor and actuator.

Controller **128** is configured to control various subsystems, components and functions of printing system **100**. The controller **128** may be implemented with general or specialized programmable processors that execute programmed instructions. These components may be provided on a printed circuit card or provided as a circuit in an application specific integrated circuit (ASIC). Each of the circuits may be implemented with a separate processor or multiple circuits may be implemented on the same processor. Alternatively, the circuits may be implemented with discrete components or circuits provided in VLSI circuits. Also, the circuits described herein may be implemented with a combination of processors, ASICs, discrete components, or VLSI circuits.

Controller **128** is operatively coupled to the print modules **102-112** and controls the timing of ink drop ejection from the print modules **102-112** onto the media web **114**. Controller **128** is also operatively connected to sensors **160-166** that enable the controller **128** to identify tension between the media web **114** and rollers **118**, **119**, **120**, and **134** from the signals generated by each sensor. Controller **128** is also operatively connected to actuators **170-174**. The controller **128** generates signals to selectively activate and deactivate each of the actuators **170-174**. The controller **128** may also adjust the speed of each actuator and corresponding rotational speed of one or more rollers that are operatively coupled to each actuator.

A user interface (UI) module **129** provides an interface for operators of the printing system **100** to set different operating modes for the controller **128**. Various implementations of the UI include mechanical controls such as knobs, switches, dials and the like, as well as graphical user interfaces (GUIs). The UI may be physically incorporated in the printing system **100**, or may be presented to a remote operator via a data network. An operator may enter various commands and parameters using the UI **129** to configure the operation of the controller **128**. In printing system **100**, the UI **129** enables the operator to place the controller **128** in an operating mode for threading the media web **114** through the media path P. The controller **128** may also enter a threading mode automatically in response to exhausting an existing media web or by detecting breakage of the media web.

In the threading operational mode, the controller **128** receives signals from each of the sensors **160-166** to identify tension levels between the media web and the rollers **118**, **119**, **120**, and **134**, respectively. The controller **128** compares the identified tension levels to predetermined threshold levels, and rotates one or more of the drive rollers **118**, **120**, and **132** by operating actuators **170**, **172**, and **174**, respectively, in response to the identified tension levels exceeding the predetermined thresholds. The drive rollers **118**, **120**, and **132** rotate to assist in threading the media web **114** through the media path P as the operator pulls the media web through the printing system **100** without requiring the operator to operate separate controls during the threading operation.

FIG. **2** depicts a block diagram of a process **200** for operating a printing system to assist in threading a media web through the printing system. Process **200** is suitable for use with the printing system **100** of FIG. **1**, and printing system **100** is described in conjunction with process **200** for illustrative purposes. Process **200** begins by providing a free end of a media web **114** to a media path P (block **204**). The free end of the media web **114** is unwound from a media web supply roller, such as roller **152**. The operator pulls the media web through the media path and engages the media web with a roller along the media path that is operatively connected to a tension sensor, such as the pre-heater roller **118**.

As the media web **114** passes the pre-heater roller **118**, the media web applies a tension to the pre-heater roller **118**. Sensor **160** generates an electrical signal corresponding to the level of tension between the media web **114** and pre-heater roller **118**, and the controller **128** receives the signal (block **208**). Controller **128** identifies the tension on the roller **118** from the generated signal (block **212**). In some embodiments, the controller **128** may identify the tension with reference to a voltage level of the signal.

If the identified tension level exceeds a predetermined threshold for roller **118** (block **216**) the controller **128** operates one or more actuators in the printing system **100** to rotate rollers positioned along the media path P (block **220**). As the media web **114** engages the pre-heater roller **118** and applies sufficient tension to the pre-heater roller **118**, the controller may operate actuator **170** to rotate the pre-heater roller **118**. The rotation of the pre-heater roller **118** pulls the media web **114** along the media path P and assists the operator in threading the media web **114** into the print zone past the print modules **102-106**.

The controller **128** continues to receive signals from the sensor **160** (block **208**) and monitors the tension on the pre-heater roller **118** (block **212**) as actuator **170** rotates the pre-heater roller **118**. If the level of tension on the pre-heater roller **118** drops below the predetermined threshold (block **216**), the controller **128** may deactivate actuator **170** until the identified tension level exceeds the predetermined threshold (block **224**). The controller **128** deactivates the actuator **170** when the tension level drops below the predetermined threshold to prevent the pre-heater roller **118** from unwinding the media web **114** too quickly during the threading process. As the media web threads past different rollers positioned on the media path, the controller **128** may deactivate one or more actuators in response to identifying the tension level between the media web **114** and any roller in contact with the media web dropping below the predetermined threshold for each roller. In an alternative configuration, the controller **128** may operate the actuator **170** for a predetermined time period in response to the sensor signal corresponding to a tension level that exceeds the predetermined threshold.

Process **200** continues as the media web **114** passes each roller positioned on the media path (block **228**). In printing system **100**, the media web **114** threads through the print zone past print units **102-106** and over apex roller **119**. The apex roller **119** is not rotated by an actuator directly, but the controller **128** identifies the level of tension placed on apex roller **119** from the electrical signals generated by sensor **162** (blocks **208** and **212**). The controller **128** operates actuator **170** to rotate the pre-heater roller **118** in response to the tension on the apex roller **119** exceeding a predetermined threshold (block **216**). The predetermined threshold tension on the apex roller **119** may be different than the predetermined threshold tension on the pre-heater roller **118**. For example, the predetermined threshold tension level on the pre-heater roller **118** may be five Newtons while the predetermined threshold tension level on the apex roller **119** is six Newtons.

In one embodiment, the controller **128** is configured to operate the one or more actuators based on the identified tension levels for all the sensors **160-166** that indicate non-zero tension values. In another embodiment, the controller **128** operates the actuators only with regard to the level of tension applied to a roller that is farthest along the media path P. The controller **128** operates the actuators to rotate the corresponding rollers at a lower rotational speed during the process **200** than during imaging operations when the media web **114** is fully threaded in the printing system **100**. In some configurations, the controller **128** adjusts the rotational speed of one or more of the drive rollers **118**, **120**, and **132** in proportion to the tension detected by the tension sensors **160-166**.

In one threading process, a human operator pulls on a free end of the media web **114**, applying tension to the media web. The tension sensors **160-166** may record potentially spurious tension signals dues to inconsistencies in the force that the human operator applies to the media web **114**. Additionally, the tension force identified by the tension sensors **160-166** changes as human applies greater or lesser forces to the media web **114**. In one embodiment, the controller **128** is configured to identify spurious tension forces applied to rollers in the printing system **100**. For example, an operator may lean against a roller during the threading process, resulting in a spurious tension measurement. The controller **128** is configured to identify a maximum expected tension for each of the tension sensors during the threading operation, and can prevent the activation of a corresponding actuator if the recorded tension exceeds the maximum expected tension.

In some configurations, the controller **128** activates one or more actuators only in response to a predetermined series of signals generated by one or more of the tension sensors **160-166**. In one configuration, the controller **128** activates one or more actuators only when a tension sensor detects two tension pulses above a predetermined threshold within a predetermined time period. For example, if the tension sensor **160** detects two tension pulses that are separated by less than three seconds from an operator who pulls on the free end of the media web **114**, then the controller **128** operates the actuator **170** to advance the media web **114**.

Referring to printing system **100**, as the media web **114** threads over the apex roller **119**, sensor **162** generates an electrical signal corresponding to the tension between the media web **114** and the apex roller **119**. The media web **114** has not yet reached the leveler roller **120** and exit guide roller **134**, so sensors **164** and **166** indicate zero tension. The controller **128** may be preconfigured to assign precedence to media rollers based on the location of the media rollers along the media path P, with media rollers that are located at more downstream positions receiving a higher precedence. Thus, controller **128** may identify a non-zero tension signal generated by tension sensor **162** coupled to the apex roller **119**, and operate the actuator **170** in response to the tension signal from the sensor **162** exceeding the predetermined tension threshold for apex roller **119**. Additionally, the controller **128** may deactivate one or more actuators if the tension level identified for apex roller **119** drops below the predetermined threshold (block **224**). In some configurations, the controller **128** continues to operate the actuators for a predetermined time after tension drops below the predetermined threshold. The continued operation of the actuators assists an operator during a threading operation when the operator momentarily reduces the force applied to the media web **114**.

Process **200** continues as the free end of media web **114** is threaded through print units **108-112** and the media web engages the leveler roller **120**. The media web applies tension to the leveler roller **120** and sensor **164** generates a signal corresponding to the tension. The controller **128** receives the signal and identifies the level of tension (blocks **208** and **212**). If the tension identified for roller **120** exceeds the predetermined tension threshold for roller **120** (block **216**), the controller **128** activates both actuators **170** and **172** to rotate drive rollers **118** and **120**, respectively (block **220**). In the example of printing system **100**, the media web **114** contacts both drive rollers **118** and **120** during the threading process, and the controller **128** is configured to operate both actuators **170** and **172** to assist in the threading process.

Process **200** continues in a similar manner as described above for threading the media web past the spreader roller **132** and exit guide roller **134**. When the media web engages the exit guide roller **134**, sensor **166** generates a signal corresponding to a level of tension between the media web **114** and the exit guide roller **134**, and the controller **128** identifies the tension level (blocks **208** and **212**). If the identified tension level exceeds the predetermined tension threshold for roller **134** (block **216**), the controller **128** activates actuators **170**, **172**, and **174** to assist in guiding the media web **114** through the media path P (block **220**). The free end of the media web **114** is wound around the take-up roller **154**, and process **200** finishes when the media web **114** is fully threaded through the printing system **100** (block **232**).

The foregoing description of process **200** as applied to printing system **100** is merely an illustrative example of a printing system configuration that assists an operator in threading a media web through a media path. The media web **114** may be threaded through the duplex path P' and then guided through the media path P at a cross-process offset position a second time to enable duplex printing. The controller **128** is configured to operate the actuators **170-174** to assist in threading the media web **114** through the duplex configuration as well as the simplex configuration. Process **200** is also suitable for use with printing systems having different numbers and arrangement of rollers, sensors, and actuators positioned along a media path than the examples described herein.

It will be appreciated that variants of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems, applications or methods. For example, while the printing system embodiments described above are inkjet printing systems, the foregoing systems and methods are applicable to any printing system where a continuous web is threaded through a media path. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements may be subsequently made by those skilled in the art that are also intended to be encompassed by the following claims.

What is claimed:

1. A method of threading a media web through a media path in a printer having a plurality of rollers positioned along the media path comprising:

generating an electrical signal with a first sensor that varies with reference to a level of tension applied by the media web to a first roller in the plurality of rollers positioned along the media path in the printer as the media web travels over the first roller;

activating with a controller at least one actuator to rotate the first roller in the plurality of rollers positioned along the media path at a rotational speed proportional to the signal generated by the first sensor that varies with reference to the level of tension applied by the media web to the first roller in response to the electrical signal generated by the first sensor exceeding a first predetermined threshold to facilitate threading of the media web past the first roller; and

activating with the controller another actuator to rotate a second roller in the plurality of rollers positioned along the media path at a rotational speed that varies with reference to a level of tension applied by the media web to the second roller to facilitate threading of the media web past the second roller.

2. The method of claim **1**, the activation of the at least one actuator further comprising:

activating the at least one actuator for a predetermined time period.

3. The method of claim 1 further comprising:

deactivating the at least one actuator with the controller in response to the electrical signal generated by the first sensor corresponding to a level of tension that is less than the first predetermined threshold after the electrical signal generated by the first sensor has exceeded the first predetermined threshold.

4. The method of claim 1 further comprising:

generating a second electrical signal with a second sensor that varies with reference to the level of tension applied by the media web to the second roller in the plurality of rollers by the media web; and

the controller is further configured to rotate the second roller in the plurality of rollers positioned along the media path at the rotational speed that varies with reference to the level of tension applied by the media web to the second roller in response to the second electrical signal generated by the second sensor that varies with reference to the level of tension applied by the media web to the second roller exceeding a second predetermined threshold.

5. The method of claim 4 wherein the second predetermined threshold is different than the first predetermined threshold.

6. A method of threading a media web through a media path in a printer comprising:

applying tension to a free end of the media web to thread the media web past a first roller arranged along the media path in the printer;

generating with a first sensor an electrical signal that varies with reference to a level of tension applied by the media web to the first roller as the media web is threaded past the first roller;

operating a first actuator with a controller to rotate a first roller positioned along the media path at a rotational speed proportional to the electrical signal generated by the first sensor that varies with reference to the level of tension applied by the media web to the first roller to facilitate threading the media web past the first roller in response to the electrical signal generated by the first sensor exceeding a predetermined first threshold level of tension;

applying tension to the free end of the media web to thread the media web past a second roller arranged along the media path in the printer;

generating with a second sensor a second electrical signal that varies with reference to a level of tension applied by the media web to the second roller as the media web is threaded past the second roller; and

operating a second actuator to rotate a second roller positioned along the media path at a rotational speed proportional to the electrical signal generated by the second sensor that varies with reference to the level of tension applied by the media web to the second roller in response to the second electrical signal generated by the second sensor that varies with reference to the level of tension applied by the media web to the second roller exceeding a predetermined second threshold to facilitate threading of the media web past the second roller.

7. The method of claim 6 wherein the first actuator rotates the first roller at a rotational speed that is slower than a rotational speed of the first roller when the media web is fully threaded through the media path.

8. A web printing system comprising:

a plurality of rollers positioned along a media path through the web printing system and configured to engage a media web;

a first sensor operatively connected to a first roller in the plurality of rollers and configured to generate an electrical signal that varies with reference to a tension applied to the first roller by the media web;

at least one actuator operatively configured to rotate the first roller in the plurality of rollers;

another actuator configured to rotate a second roller in the plurality of rollers; and

a controller operatively connected to the first sensor, the at least one actuator and the other actuator, the controller being configured to identify a level of tension applied to the first roller with reference to the electrical signal that varies with reference to the level of tension applied to the first roller, compare the identified level of tension to a first predetermined threshold, operate the at least one actuator to rotate the first roller in the plurality of rollers at a rotational speed proportional to the electrical signal generated by the first sensor that varies with reference to the level of tension applied by the media web to the first roller, the rotational speed being slower than an operating rotational speed, in response to the identified level of tension exceeding the first predetermined threshold, and to operate the other actuator to rotate the second roller at a rotational speed that varies with reference to a tension applied by the media web to the second roller to facilitate threading of the media web past the second roller.

9. The web printing system of claim 8, the controller being further configured to operate the at least one actuator to rotate the first roller for a predetermined time period.

10. The web printing system of claim 8, the controller being further configured to deactivate the at least one actuator in response to the electrical signal generated by the first sensor corresponding to a level of tension that is less than the first predetermined threshold after the electrical signal generated by the sensor exceeds the first predetermined threshold.

11. The web printing system of claim 8 further comprising:

a second sensor operatively connected to the controller and to the second roller in the plurality of rollers, the second sensor being configured to generate an electrical signal that varies with reference to a tension applied to the second roller by the media web; and

the controller being further configured to identify a second level of tension applied to the second roller with reference to the second electrical signal, compare the second identified level of tension to a second predetermined threshold, and operate the other actuator to rotate the second roller in the plurality of rollers at the rotational speed that is proportional to the tension applied by the media web to the second roller in response to the signal generated by the second sensor that varies with reference to the level of tension applied by the media web to the first roller exceeding the second predetermined threshold.

12. The web printing system of claim 11, wherein the second predetermined threshold is different than the first predetermined threshold.

* * * * *